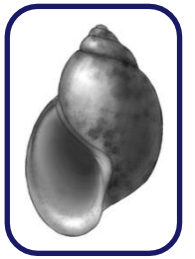
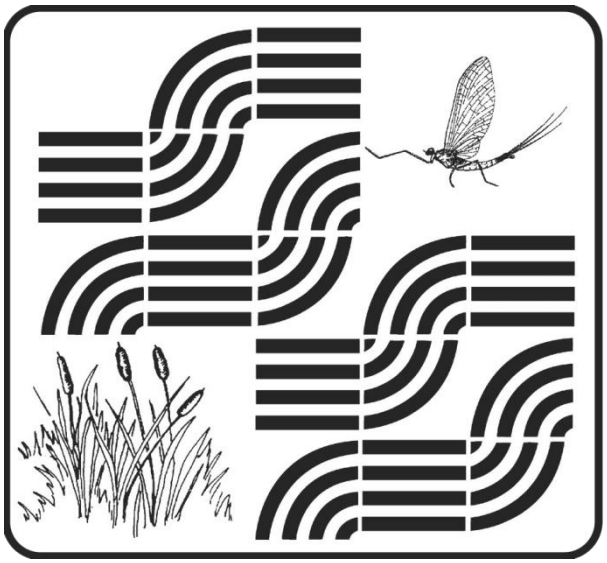
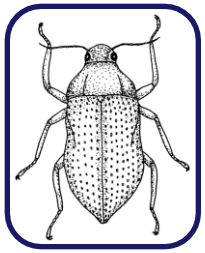
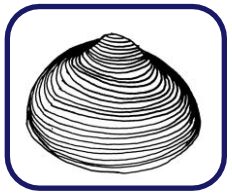
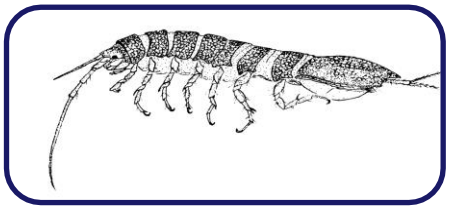
Georgia Adopt-A-Stream
Macroinvertebrate Training











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GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Revised November 2017

Georgia Adopt-A-Stream

- What is it?

  Georgia's volunteer water quality monitoring program

- Program Goals

  A: Increase public **awareness**

  D: Collect quality baseline water quality **data**

  O: Gather **observations**

  P: Encourage **partnerships** between citizens & local government

  T: Provide **tools & training**

Macroinvertebrate Monitoring

Involves: collecting, identifying, and counting macros

Purpose: to quickly assess both **water quality and habitat quality**

Characterizes stream health by abundant and diverse macroinvertebrate populations

(**however our macro key places importance on diverse populations**)

EPA Quality Assurance Project Plan

- Quality Assurance
  Quality Control (QA/QC)
- Only individuals are certified
- Certification is valid for one year

- Volunteers must attend an annual recertification workshop
- Only certified volunteers can submit data!

To Become a Certified QA/QC Volunteer…

- In the field, volunteers must demonstrate the ability to collect a macroinvertebrate sample
- Volunteers must pass a written evaluation with a score of at least 80%
- Must identify at least 20 macroinvertebrates with >90% accuracy

What is a Watershed?

- A watershed is the land area from which water, sediment, and dissolved materials drain to a common point along a stream, wetland, lake or river.

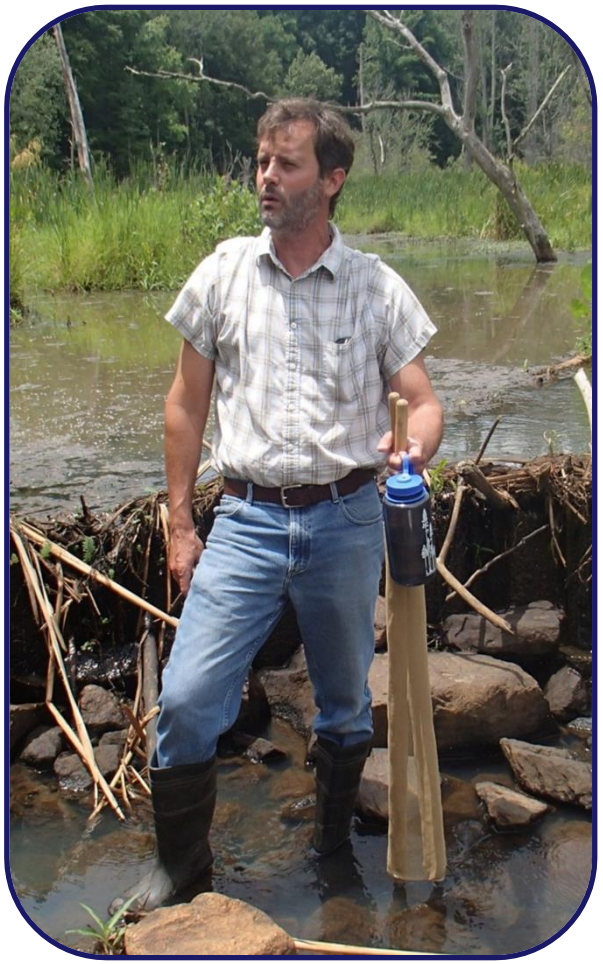
- Its boundaries are marked by the highest points of land around the waterbody.

Where, When and How Often?

- Where: Same site location

- When: Same time of day and during normal flow conditions. Should take 1 ½ - 2 hours.

- How often: **Once every 3 months or every season**



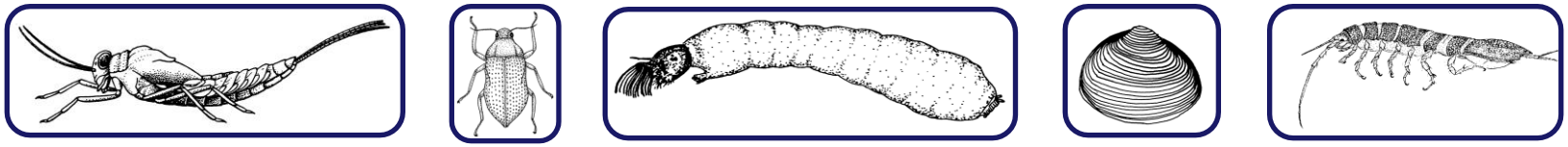
Safety Considerations

If conditions are too dangerous to sample…

DON'T SAMPLE!

- Wait until storm has stopped and strong flow has subsided
- Never sample alone
- Remember to wear gloves and boots for protection at site
- Receive permission from land owner before going onto private property

What are Macroinvertebrates?



- Organisms that lack a backbone and can be seen with the naked eye such as aquatic insects, mollusks and crustaceans
- The organisms that we will be sampling for are benthic macroinvertebrates – macros that live in the substrate, or bottom, of a water body
- Macros live in various stream habitats and **derive their oxygen from the water**
- These organisms are impacted by all the stresses that occur in a stream environment, both man-made and naturally occurring

Macroinvertebrates as Indicators of Water Quality

- **Not very mobile**
- **Present during ALL stream events**
  - **Recent heavy rains can affect results**
- **Relatively easy to catch, view and identify**
- **They are affected by the physical, chemical and biological conditions of the stream**
- **Values may differ in north and south Georgia**

Stream Habitats

- Vegetative margins - area along the edge of water body consisting of overhanging bank vegetation
- Substrate
  - Sand/rock/gravel streambed - area of stream with coarse substrate
  - Riffles - shallow area of a stream in which water flows rapidly over a rocky or gravelly stream bed
- Organic Matter
  - **Leaf packs – decomposing vegetation that is submerged in the water**
  - **Woody debris – decomposing trees, roots, or branches that are submerged in the water**

Stream and Sampling Types

Rocky Bottom Streams

- Generally found in North GA and Piedmont Region
- Characterized by fast moving water flowing over large rocks and boulders
- Stream stretch consist of pool/riffle system

Muddy Bottom Streams

- Found mostly in South GA and urban environments due to erosion and sedimentation
- Slow moving water with little or no turbulence
- Substrate is generally composed of fine silt, sand or coarse gravel

If your stream shows traits of both categories,
do your best to CHOOSE ONE and proceed with that method!

Rocky Bottom Sampling Method

Sample TWO different habitats using a **kick seine**

3 Substrate

Sample 2x2 foot area with kick seine net in riffle areas

4 Organic Matter

Using both hands, take 4 handfuls (1 square foot) of **decayed**, **submerged** leaf packs

Muddy Bottom Sampling Method

Sample THREE different habitats using a **D-frame net**

7 Vegetative Margins

7 scoops (1 square foot)

4 Organic Matter

4 scoops (1 square foot) in woody debris

3 Substrate

3 scoops (1 square foot) of sand/rock/gravel or coarsest area of streambed

Tip: Try to avoid collecting a lot of sand to save time

Pollution Sensitive *Organisms*

Require High Levels of Dissolved Oxygen

Found In Good Quality Water

Somewhat Pollution Tolerant *Organisms*

Require Moderate Levels of Dissolved Oxygen

Found In Good or Fair Quality Water

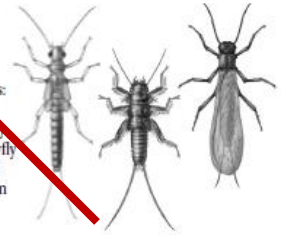
Pollution Tolerant *Organisms*

Can Survive in Low Levels of Dissolved Oxygen

Found In Any Quality Water

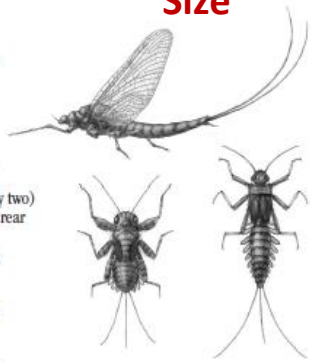
INSECTS

Stoneflies
Order: Plecoptera
Size: ½" to 1½"
Tolerance: Sensitive
Distinguishing Characteristics:
- Two hair-like tails
- No gills on rear half of body
- Structurally similar to mayfly nymphs, but have two tails instead of the usual three in mayflies
- 2 claws on each foot



Size

Mayflies
Order: Ephemeroptera
Size: ¼" to 1"
Tolerance: Sensitive
Distinguishing Characteristics:
- Usually three long, hair-like tails (but sometimes only two)
- Gills present on the rear half of body
- 1 hook on each foot

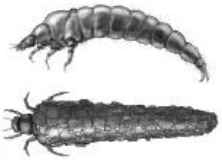


Water Pennies
Order: Coleoptera
Size: up to ½"
Tolerance: Very sensitive
Distinguishing Characteristics:
- Looks like a flat, oval disc
- Plates extend from all sides
- Cannot survive on rocks covered with excessive algae or inorganic sediment

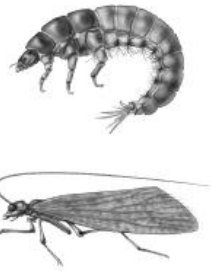
Riffle Beetles
Order: Coleoptera
Size: 1/16" to 1/8"
Tolerance: Sensitive
Distinguishing Characteristics:
- Very small
- Dark colored
- Adult riffle beetles will be found walking on the bottom of the stream

Aquatic Snipe Flies
Order: Diptera
Size: ¼" to 1"
Tolerance: Sensitive
Distinguishing Characteristics:
- Body is pale brown to green color
- Mostly cylindrical, with the front tapering to a cone-shaped point
- Larva have a number of mostly paired caterpillar-like prolegs
- Two stout, pointed tails with feathery hairs at back end

Caddisflies
Order: Trichoptera
Size: ½" to 1 ½"
Tolerance: Sensitive
Distinguishing Characteristics:
- Larva is caterpillar-like with three pairs of legs and tends to curl up slightly
- Two claws at posterior (rear) end
- May be found in a stick, rock, or leaf case with its head sticking out

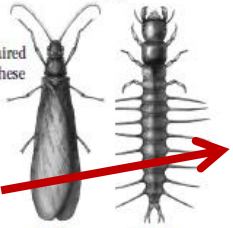


Common Net Spinning Caddisflies
Order: Trichoptera
Family: Hydropsychidae
Size: up to 1"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Body is caterpillar-like with three pairs of legs and is strongly curved
- Dorsal plates (sclerites) on all three thoracic segments
- Branched gills on the ventral surface of the last two thoracic segments and most of the abdominal segments
- Usually have a bristle-like, setal tuft at the end of each anal proleg
- Color varies from bright green to dark brown



Dobsonflies/Hellgrammites and Fishflies
Order: Megaloptera
Size: ¾" to 4"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Stout body with large pinching jaws
- Eight pairs of pointed lateral appendages
- On the rear end of the body a pair of stubby, unjointed legs (prolegs), each with a pair of claws
- Dobsonflies/Hellgrammites have paired cotton-like gill tufts, fishflies lack these
- Fishflies have two short tube-like structures on the tail end

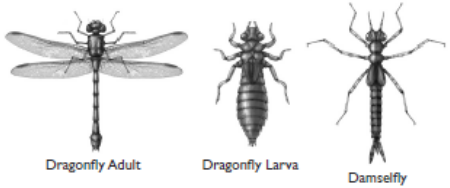
Dobsonfly Larva



Fishfly Adult | Fishfly Larva

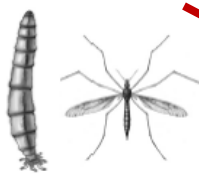
Distinguishing Characteristics

Damselflies and Dragonflies
Order: Odonata
Size: ½" to 2"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Both have large eyes, six legs, and a large lower lip that covers much of the bottom of the head
- Damselflies are slender and have three oar shaped tails (gills)
- Dragonflies have a stocky body without tails



Dragonfly Adult | Dragonfly Larva | Damselfly

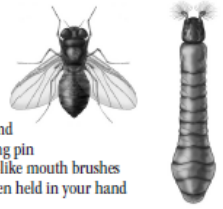
Crane Flies
Order: Diptera
Size: ⅓" to 2 ½"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Worm-like plump body
- Can be found in a variety of colors (clear, white, brown, and green)
- Segmented body with finger-like projections (gills) at the back end
- Head is usually pulled back into the front of the body



Midge Flies
Order: Diptera
Size: up to ¼"
Tolerance: Tolerant
- They can indicate poor stream health caused by pollution if found in large numbers

Distinguishing Characteristics:
- Often whitish to clear, but occasionally bright red
- Segmented body
- Has distinct head with two small prolegs in the front of the body
- Display a spastic squirming action in the water

Black Flies
Order: Diptera
Size: up to ¼"
Tolerance: Tolerant
Distinguishing Characteristics:
- The body is larger at the rear end similar to the shape of a bowling pin
- The distinct head contains fan-like mouth brushes
- Often curl into a "u" shape when held in your hand

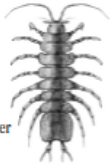


CRUSTACEANS

Crayfish
Order: Decapoda
Size: up to 5"
Tolerance: Somewhat sensitive
- Can withstand large ranges of pH and temperatures and is sensitive to toxic substances

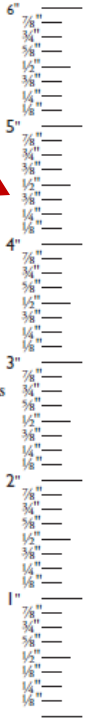
Distinguishing Characteristics:
- Resembles a lobster
- Has 10 legs and the two front legs have large claws or pinchers

Aquatic Sow Bugs
Order: Isopoda
Size: ¼"- ¾"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Flat, segmented body
- Has an "armored" appearance
- Seven pairs of legs
- Can be confused with scuds, however they are flattened top to bottom



Length Reference

Scuds
Order: Amphipoda
Size: ⅛" to ¼"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Resemble a small shrimp
- Translucent body with silvery-gray or tan coloration
- Seven pairs of legs
- Unlike sow bugs, scuds are flattened side to side



WORMS

Aquatic Worms
Class: Oligochaeta
Size: Usually 1" but up to 4"
Tolerance: Tolerant
Distinguishing Characteristics:
- Can be very tiny and slender or look similar to earthworms
- No legs, distinct head or any mouthparts
- Segmented body
- Aquatic worms can indicate organic pollution when they dominate the majority of the sample collection

Leeches
Class: Hirudinea
Size: ¼" to 2"
Tolerance: Tolerant
Distinguishing Characteristics:
- Somewhat slimy, soft, segmented body
- Two suckers on the underside of the body, one in the front and one in the rear
- Can be confused with a flatworm, however flatworms have no suckers and leeches have fine lines (annuli) across the body

GEORGIA ADOPT-A-STREAM: Macroinvertebrate Form (page 1)

To be conducted quarterly

SITE INFORMATION

Group Name:_____ Event Date: _____ (MMDDYYYY)

Group ID: G-_____ Site ID: S-_____ Time Sample Collected:_____ (HHMM am/pm)

Stream Name:_____ Time Spent Sampling: _____ (Min)

Monitor(s):_____ Total Time Spent Traveling *(optional)* : _____ (Min)

Number of Participants:_____ Furthest Distance Traveled *(optional)* : _____(Miles)

WEATHER

Present conditions (check all that apply)

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Overcast ☐ Partly Cloudy ☐ Clear/Sunny

Amount of rain, if known?

Amount in Inches:_____

In Last Hours/Days:_____

*Refer to *wunderground.com* for rainfall data

OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☐ Normal ☐ High ☐ Flood (over banks)

Water Clarity: ☐ Clear/Transparent ☐ Cloudy/Somewhat Turbid ☐ Opaque/Turbid ☐ Other:_____

Water Color: ☐ No Color ☐ Brown/Muddy ☐ Green ☐ Milky/White ☐ Tannic ☐ Other:_____

Water Surface: ☐ Clear ☐ Oily sheen: Does it break when disturbed? Yes/No (circle one) ☐ Algae

☐ Foam ◯ Greater than 3" high ◯ It is pure white ☐ Other:_____

Water Odor: ☐ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg

☐ Fishy ☐ Chlorine ☐ Other:_____

Trash: ☐ None ☐ Yes, I did a cleanup ☐ This site needs an organized cleanup

Photos: Please take images to document your observations and changes in water quality conditions. Photo point directions can be found in the manuals. Images can be submitted online with your other data.

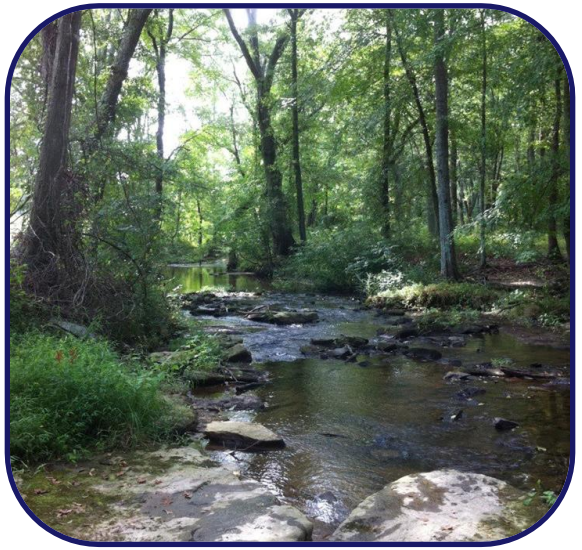
COMMENTS

Any changes since you last sampled at this site? If yes, please describe.

Please submit data to our online database at www.AdoptAStream.Georgia.Gov

Observations

- Flow/Water Level
- Water Clarity
- Water Color
- Water Surface
- Water Odor
- Trash
- Photos



OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☐ Normal ☐ High ☐ Flood (over banks)

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Water Surface: ☐ Clear ☐ Oily sheen: Does it break when disturbed? Yes/No (circle one) ☐ Algae
☐ Foam ◯ Greater than 3" high ◯ It is pure white Other:_____

Water Odor: ☐ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg
☐ Fishy ☐ Chlorine ☐ Other:_____

Photos: Please take images to document your observations and changes in water quality conditions.
Photo point directions can be found in the manuals. Images can be submitted online with your other data.

Trash: ☐ None ☐ Yes, I did a cleanup ☐ This site needs an organized cleanup

Calculate Your Results

This form calculates the water quality rating based on the abundance and, **more importantly, the diversity** of benthic macroinvertebrates found

GEORGIA ADOPT-A-STREAM: Macroinvertebrate Form (page 2)

METHODS

Stream Type: ☐ Rocky Bottom Stream ☐ Muddy Bottom Stream

Method Used: ☐ Kick seine (2 x 2 ft area) ☐ D-Frame net (1 x 1 area) **Total Area Sampled:** _____ ft^2

Habitats Sampled: ☐ Leaf Packs/Woody Debris ☐ Vegetated Bank Margin ☐ Riffle ☐ Streambed with silty area (very fine particles) ☐ Streambed with Sand or small gravel

Directions: ***Consult the macroinvertebrate monitoring manual for sampling guidelines***

1. Separate the macroinvertebrates into the different taxa groupings listed in the table below.

2. Note which **taxa** are present and their **abundance code** based on the number of individuals present in your sample. Enter these codes in the boxes below for each taxa. *Abundance Codes:* **R** (rare)=1-9, **C** (common)=10-99, and **D** (dominant)=100 individuals or greater

TAXA GROUPS

SENSITIVE TAXA	SOMEWHAT SENSITIVE TAXA	TOLERANT TAXA
☐ Stonefly Nymphs	☐ Common Net Spinning Caddisflies	☐ Midge Fly Larvae
☐ Mayfly Nymphs	☐ Dobsonfly/Helgrammite & Fishfly	☐ Black Fly Larvae
☐ Water Penny Larvae	☐ Dragonfly & Damselfly Nymphs	☐ Lunged Snails
☐ Riffle Beetle Larvae/Adults	☐ Crayfish	☐ Aquatic Worms
☐ Aquatic Snipe Flies	☐ Crane Flies	☐ Leeches
☐ Caddisflies	☐ Aquatic Sow Bugs	
☐ Gilled Snails	☐ Scud	
	☐ Clams & Mussels	

WATER QUALITY INDEX/RATING

☐ # of taxa groups times 3 =____ ☐ # of taxa groups times 2 =____ ☐ # taxa groups times 1 =__

Now add together the three index values to get your **Water Quality Index Score** =_____
Use this score to find out your **Water Quality Rating** for your stream (below).
Good water quality is indicated by a variety of different kinds of taxa/organisms, with no one kind making up a majority of the sample.

Water Quality Rating

☐ *Excellent (>22)* ☐ *Good (17-22)* ☐ *Fair (11-16)* ☐ *Poor (<11)*

OTHER

Optional: Do you see any of the following in your samples? Please count number of individuals.

☐ Fishes # :_____ ☐ Tadpoles # :_____
☐ Asian Clams # :_____ ☐ Nonnative Crayfish Which species?
☐ Salamanders # :_____ _____

After Calculating Your Results…

If you find:		**You may have**:
A variety of macroinvertebrates, lots of each kind	→	Healthy stream
Little variety, with many of each kind	→	Water enriched with organic matter
A variety of macroinvertebrates, but a few of each kind, or NO macroinvertebrates but the stream appears clean	→	Toxic pollution
Few macroinvertebrates and the streambed is covered with sediment	→	Poor habitat from sedimentation

Submit the Data

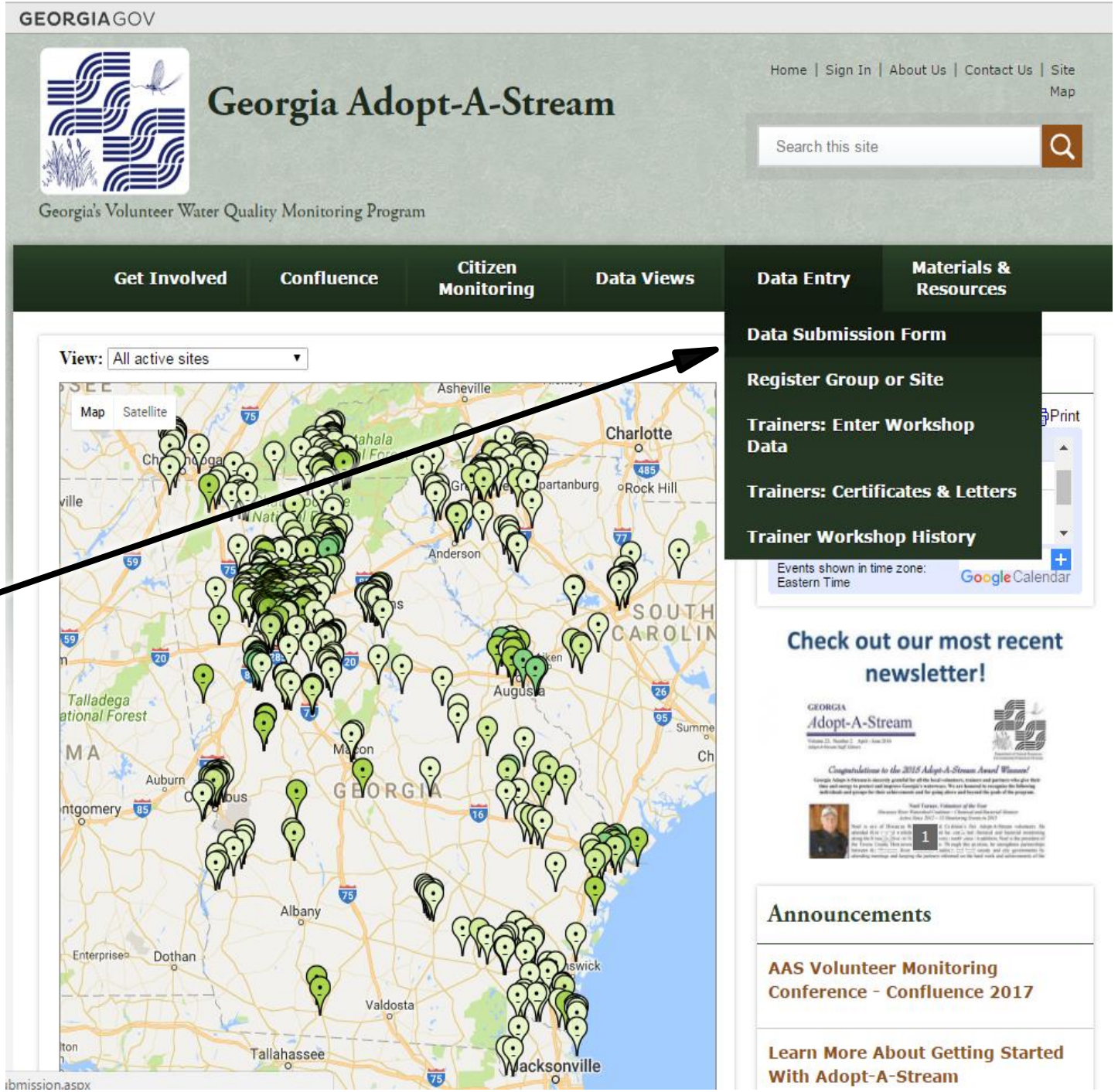
As soon as possible after monitoring is complete

Data should be submitted to the state program's **online database**:

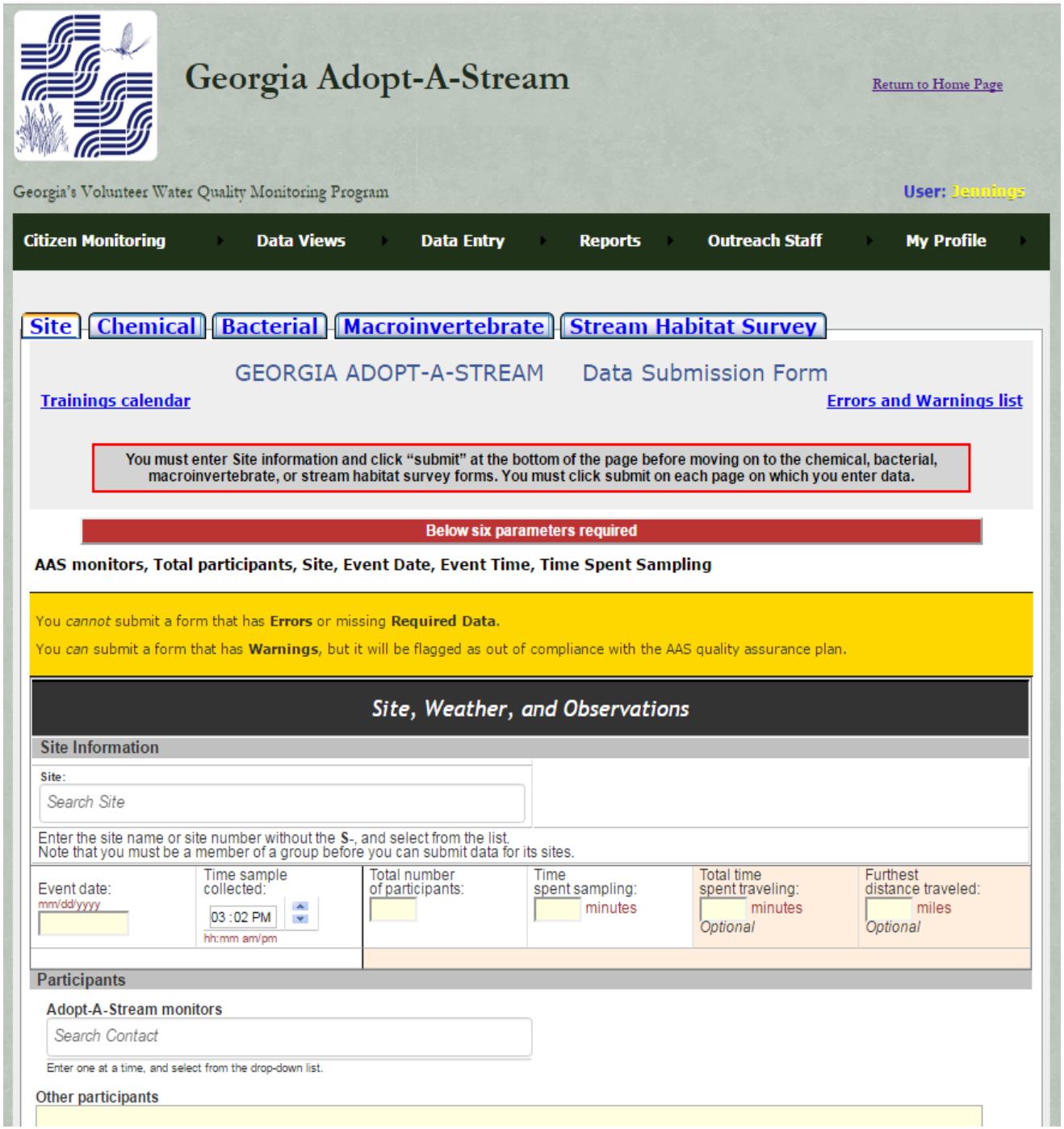
AdoptAStream.Georgia.gov

Share your data with partners, local governments and your local Adopt-A-Stream coordinators

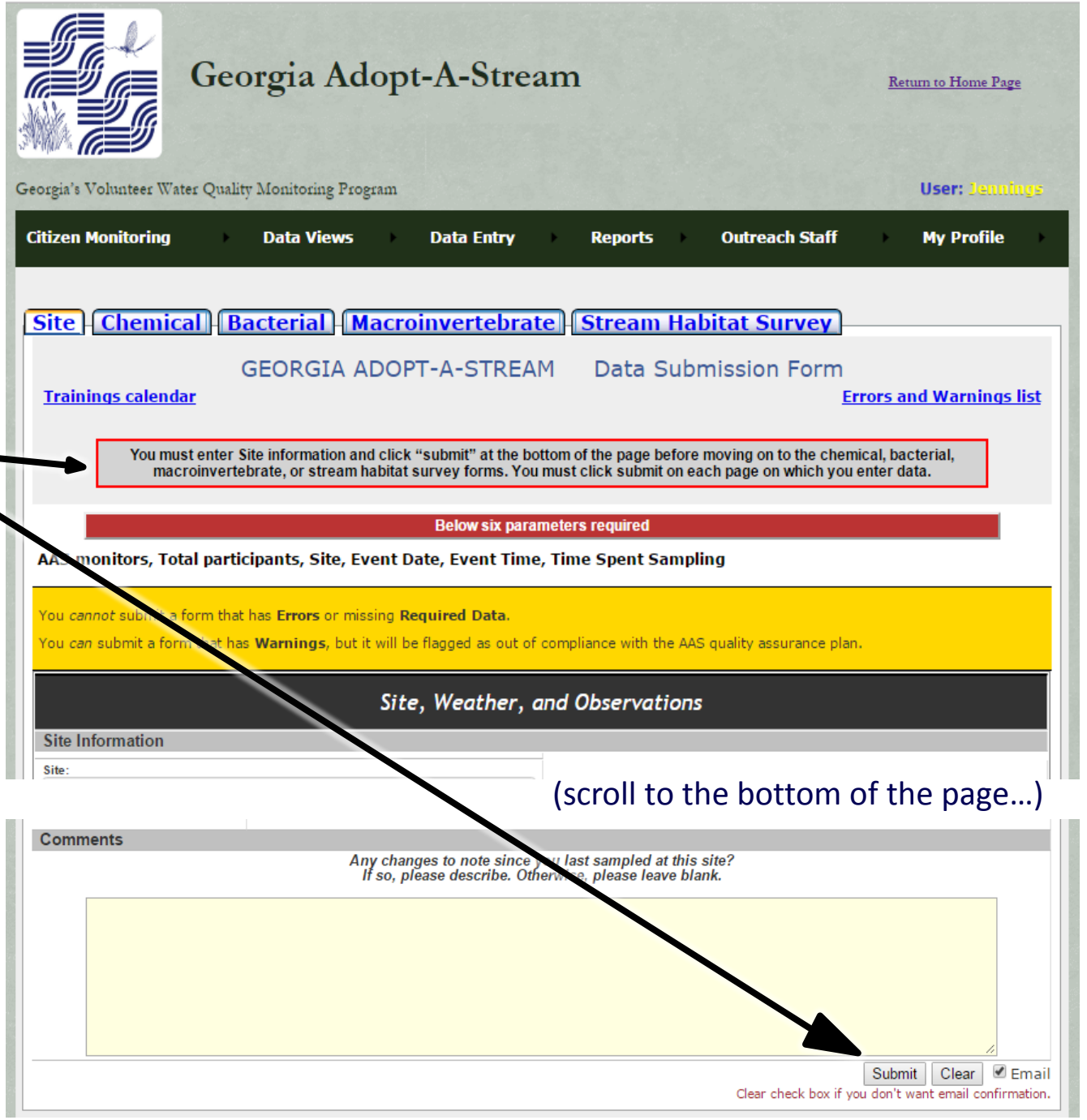
From the website's Home Page, select "Data Submission Form" under the Data Entry tab.



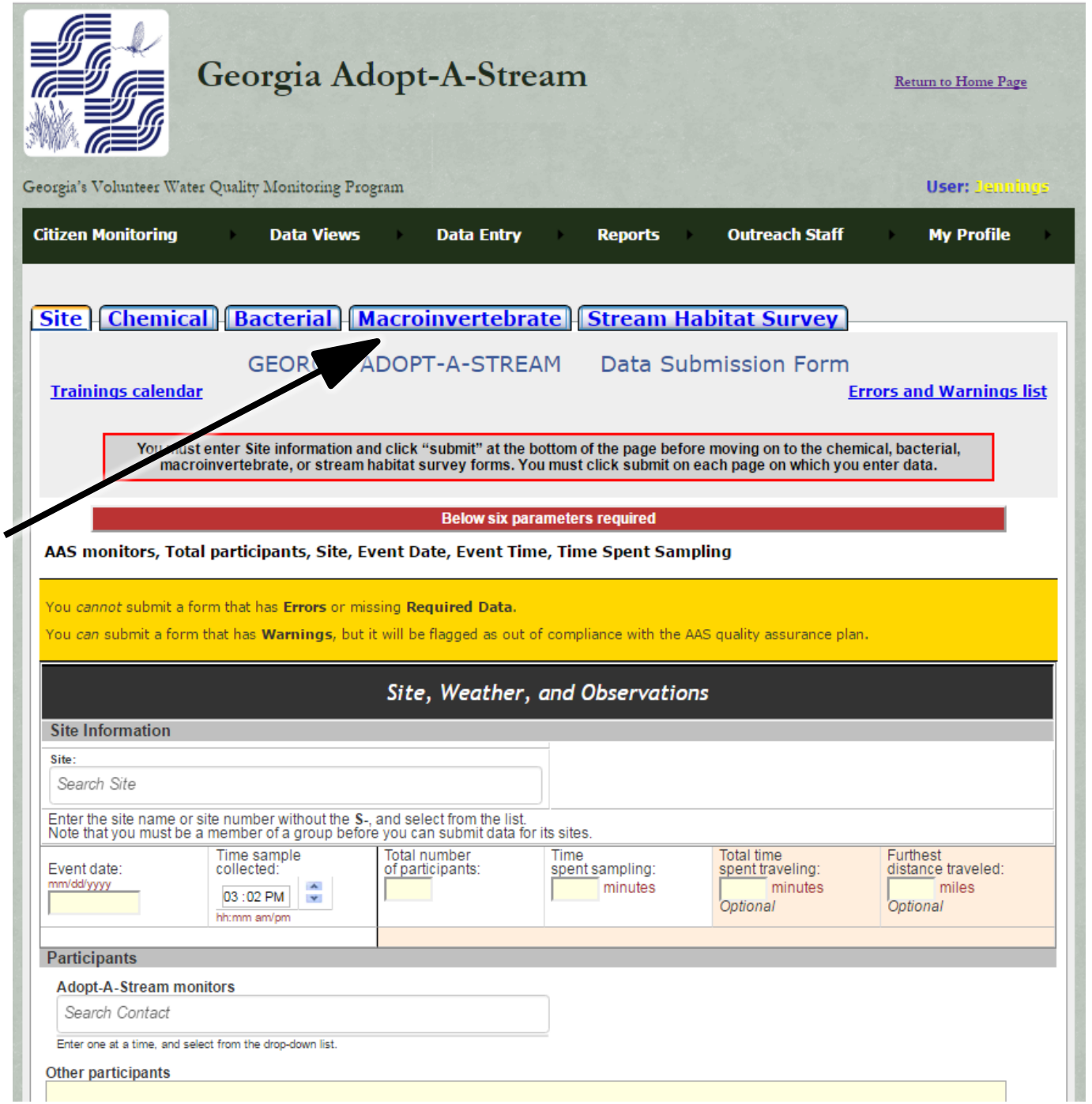
Enter your site information as well as any weather and observation information on this page.



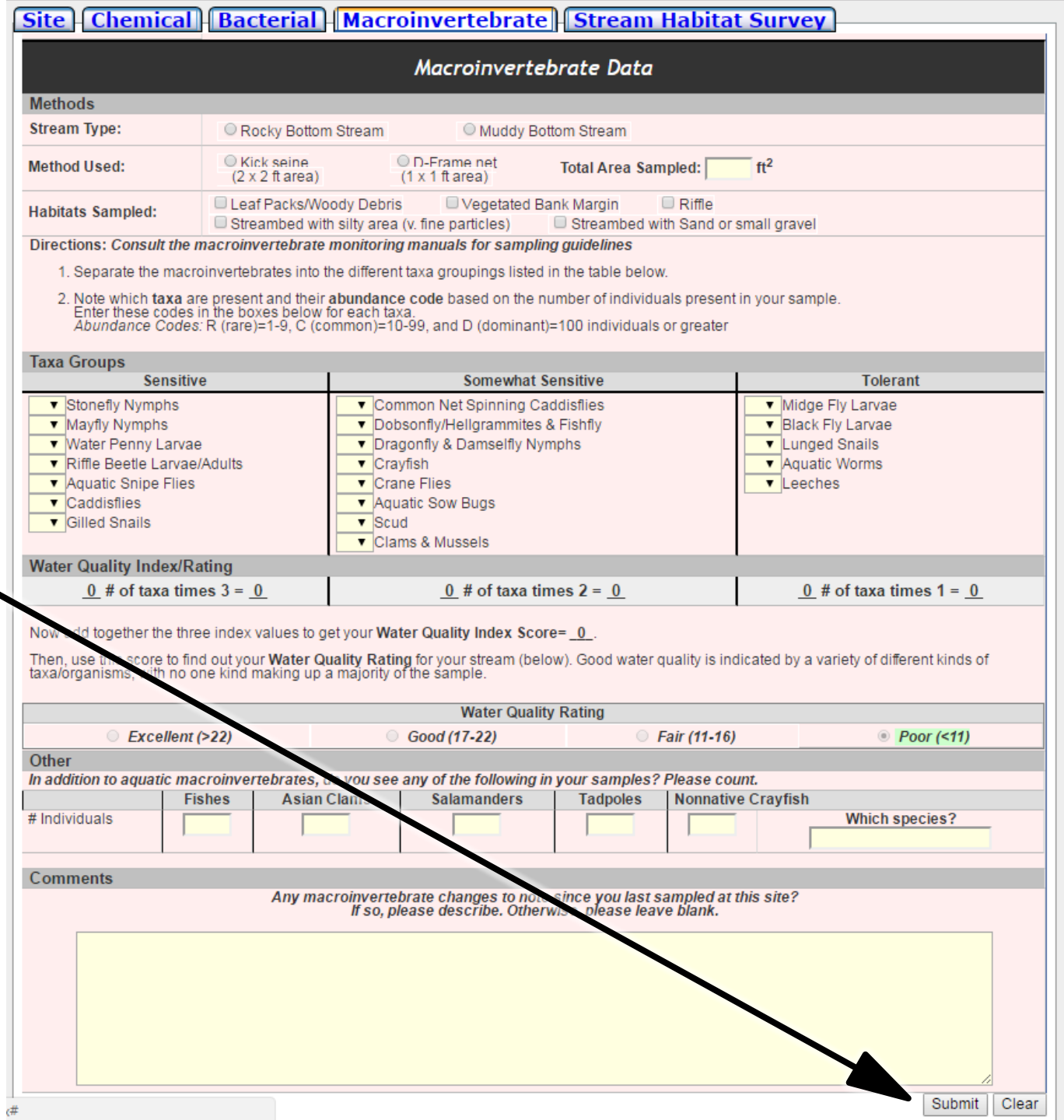
Click “Submit” at the bottom of the page to record your data. You must submit your site data before you can enter macro-invertebrate data



After clicking "Submit," click on the Macro-invertebrate tab to continue entering data



Fill out the form and click “Submit” to record your data!



Site | Chemical | Bacterial | Macroinvertebrate | Stream Habitat Survey

Macroinvertebrate Data

Methods

Stream Type: ○ Rocky Bottom Stream ○ Muddy Bottom Stream

Method Used: ○ Kick seine (2 x 2 ft area) ○ D-Frame net (1 x 1 ft area) **Total Area Sampled:** _____ ft²

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Taxa Groups

Sensitive	Somewhat Sensitive	Tolerant
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Mayfly Nymphs	Dobsonfly/Hellgrammites & Fishfly	Black Fly Larvae
Water Penny Larvae	Dragonfly & Damselfly Nymphs	Lunged Snails
Riffle Beetle Larvae/Adults	Crayfish	Aquatic Worms
Aquatic Snipe Flies	Crane Flies	Leeches
Caddisflies	Aquatic Sow Bugs	
Gilled Snails	Scud	
	Clams & Mussels	

Water Quality Index/Rating

0 # of taxa times 3 = 0	0 # of taxa times 2 = 0	0 # of taxa times 1 = 0

Now add together the three index values to get your **Water Quality Index Score=** 0.

Then, use this score to find out your **Water Quality Rating** for your stream (below). Good water quality is indicated by a variety of different kinds of taxa/organisms, with no one kind making up a majority of the sample.

Water Quality Rating			
○ *Excellent (>22)*	○ *Good (17-22)*	○ *Fair (11-16)*	◉ *Poor (<11)*

Other

In addition to aquatic macroinvertebrates, did you see any of the following in your samples? Please count.

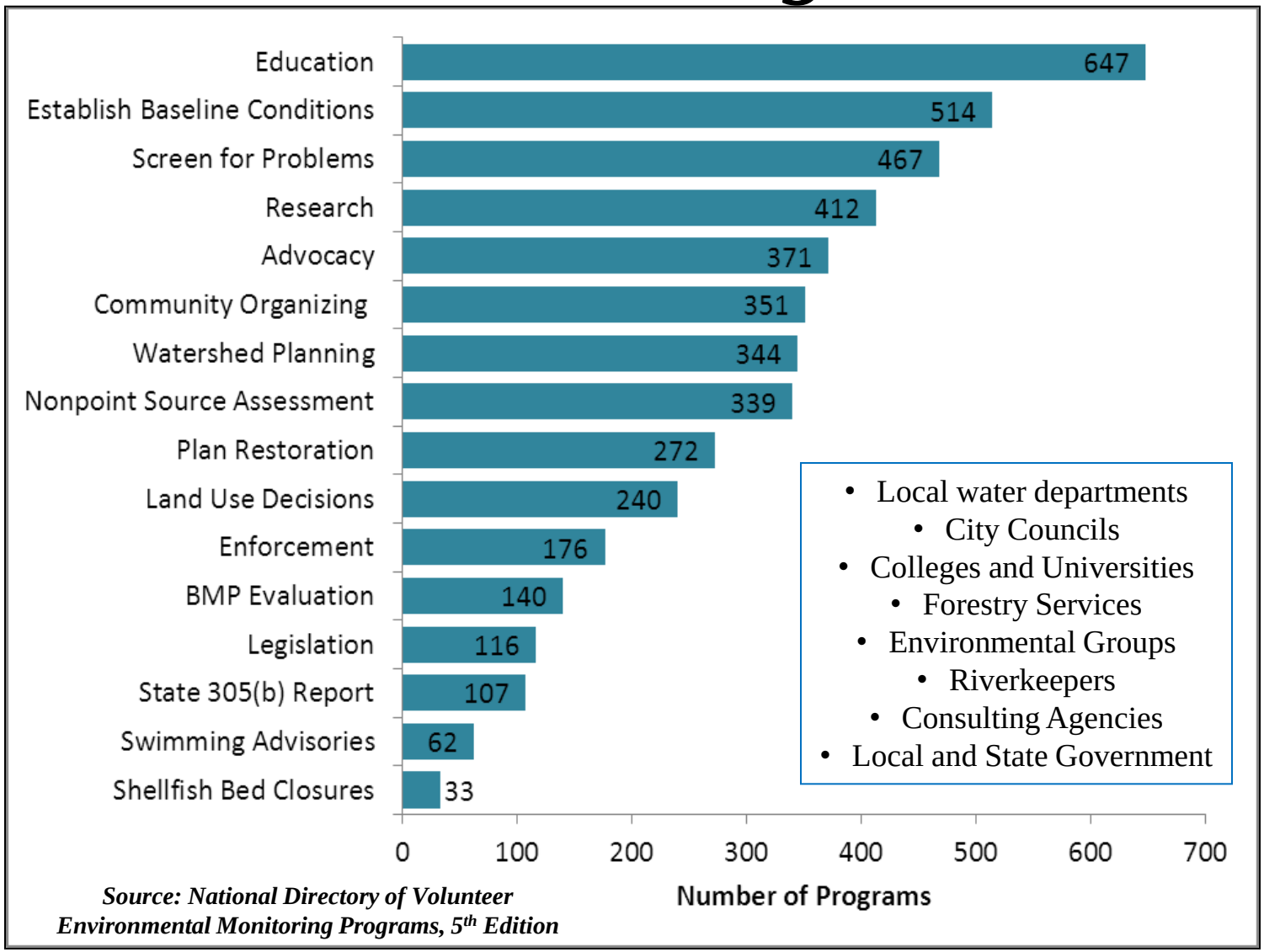
	Fishes	Asian Clam	Salamanders	Tadpoles	Nonnative Crayfish	
# Individuals						Which species?

Comments

Any macroinvertebrate changes to note since you last sampled at this site? If so, please describe. Otherwise, please leave blank.

Submit Clear

Volunteer Monitoring Data Uses



Source: National Directory of Volunteer Environmental Monitoring Programs, 5th Edition

Just the Facts

A: awareness
D: data
O: observations
P: partnerships
T: tools & training

AAS Macro Key: DISSOLVED OXYGEN

Data – On-line database as soon as possible, local program, city & county government & municipality, partners, county commissioners, universities, others.

South vs. North Georgia

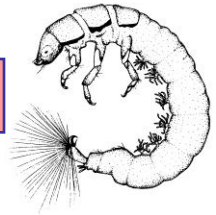
Diversity vs. Abundance

Invertebrates are mobile(not!)

Decomposing organic matter

Water & Habitat Quality

Vs.



quarterly/every season/every 3 months

Invertebrate ID!!

Storm events

	Methods		Habitat Type		
	Net Used	***Area Sampled***	***Veg Margin***	***Organic Matter***	***Substrate***
Rocky Bottom	Kick Seine	2ft X 2ft	None	4 grabs (1ft x 1ft)	3 kicks
Muddy Bottom	D-Frame	1ft X 1ft	7 scoops	4 scoops	3 scoops

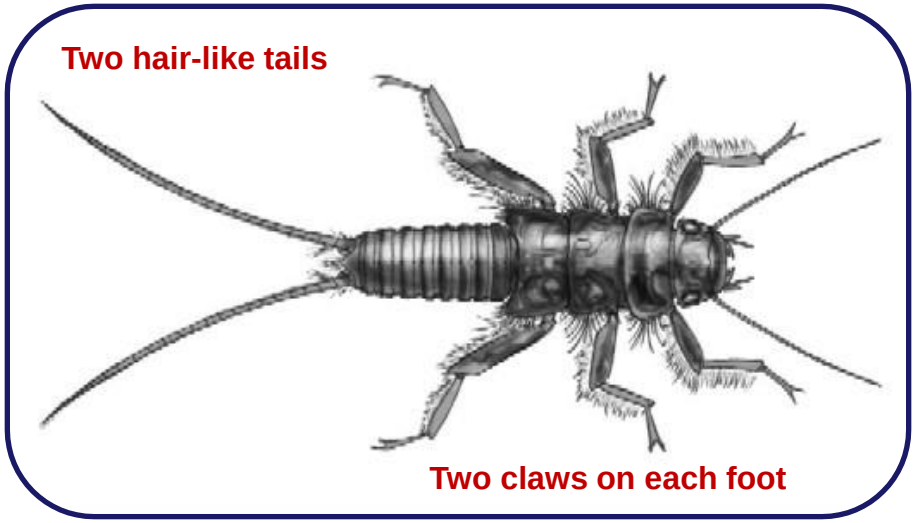
Macro ID

Pollution Sensitive Organisms

Require High Levels of Dissolved Oxygen
Found In Good Quality Water

STONEFLY NYMPH

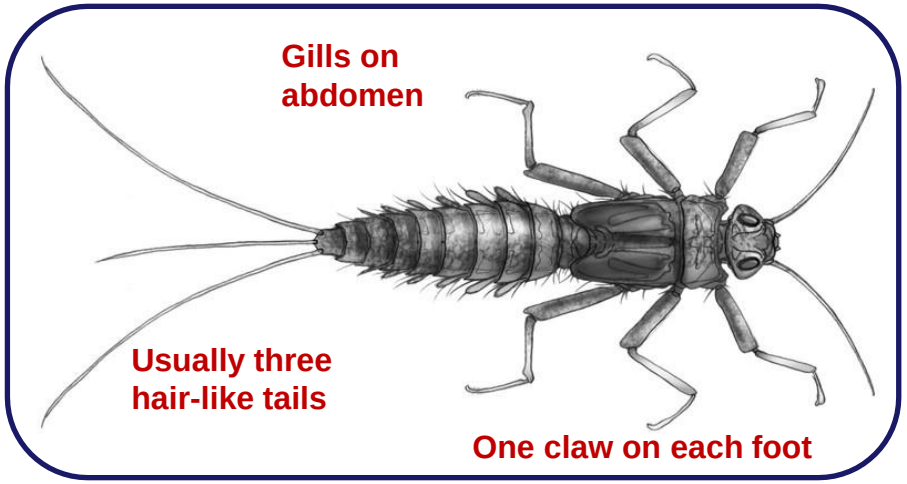
- Measure **½ – 1 ½ inches** in length (not including tails)
- 2 sets of wing pads
- Branched gills between legs on underside of body
- Yellow to brown in color



- Superficially similar to certain flattened mayfly nymphs, however stonefly nymphs always have **two tails, prominent antennae, and two claws at the end of each leg**.
- Stoneflies do not tolerant low levels of dissolved oxygen and therefore prefer cold, swift-moving streams. The streamlined, flattened bodies of stonefly nymphs enable them to move about the rocky streambed in rapid currents.

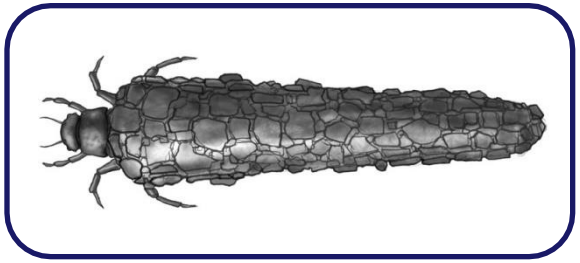
MAYFLY NYMPH

Similar to a stonefly, but with **noticeable gills on abdomen** and **three tails** instead of two

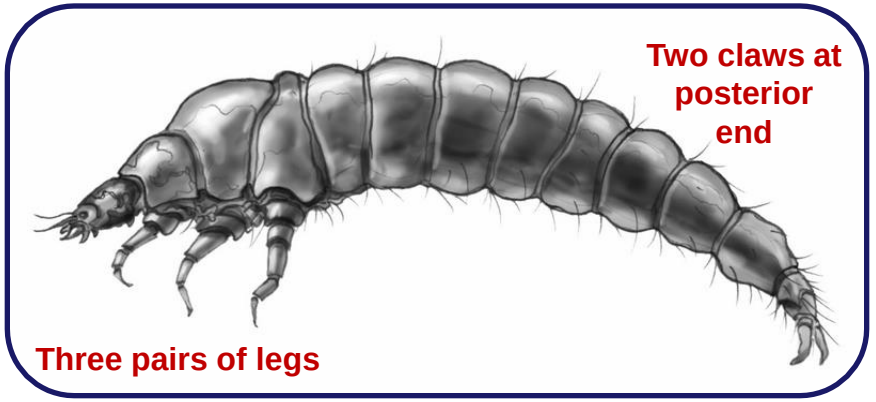


- Mature nymphs measure **up to 1 inch** in length (excluding tails)
- Two rows of long hairs present on inside of front legs, used for filtering food particles from the water.
- Slender antennae
- May be minnow like with a vertically oriented head and three tails (as pictured) or may be more flattened with a horizontally oriented head and two tails.

CADDISFLY NYMPH

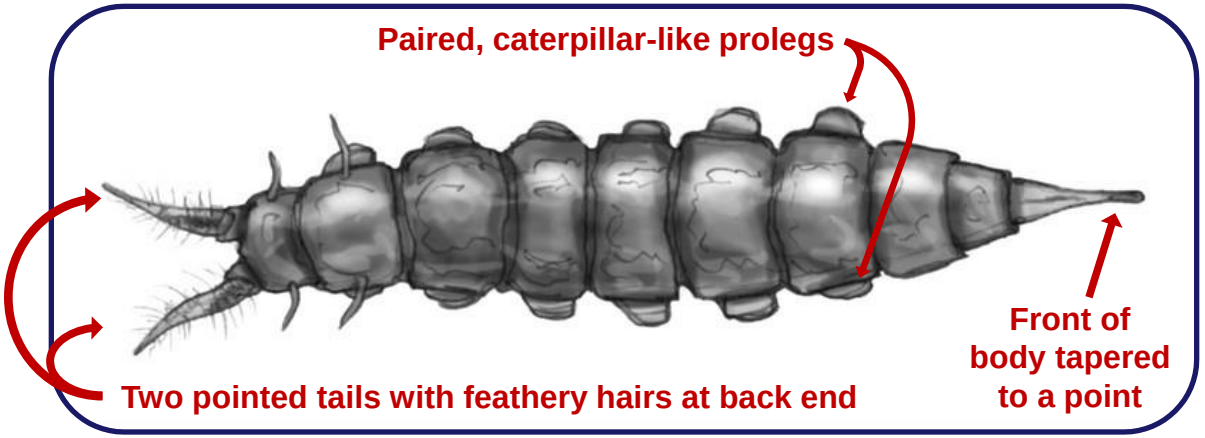


Builds distinctive cases made of sticks, rocks, sand, plant material and/or other debris



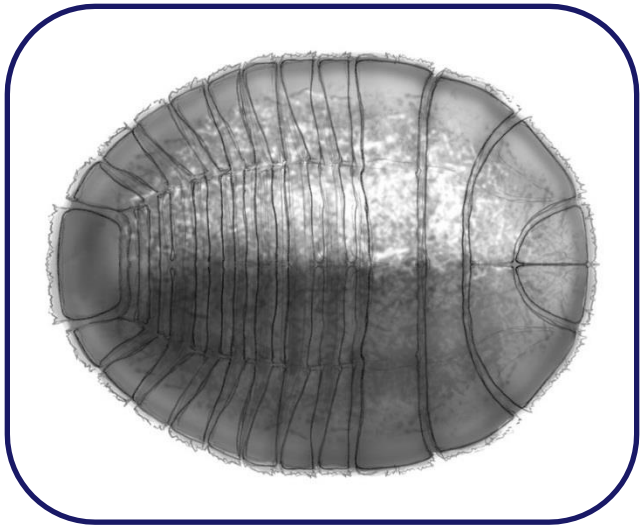
- **Up to 1½ inch** in length
- Antennae reduced and inconspicuous
- Curls up slightly (not as tightly as the common net-spinning caddisfly)

AQUATIC SNIPE FLY LARVA



- Measure **¼ - 1** inch in length
- Mostly cylindrical, with the **front tapering to a cone-shaped** point
- Body is pale brown to green color
- Larva have a number of mostly paired caterpillar-like prolegs
- Two stout, pointed tails with feathery hairs at back end

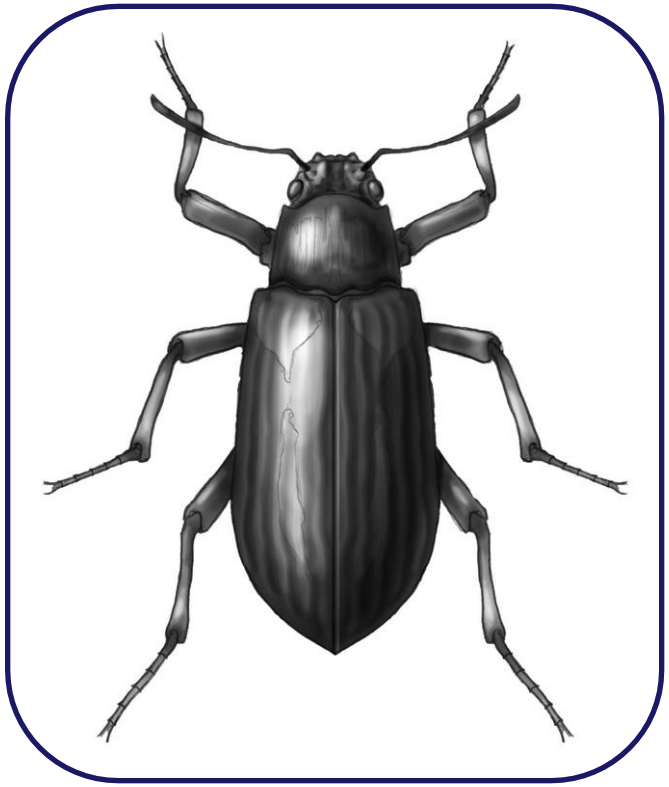
WATER PENNY



- Measures **½ inch** in length
- **Flat disk-like body**
- Head and legs concealed from above
- 6 legs and branched gills on underside
- Prefers cold running water
- Water pennies prefer cold, fast-moving streams. Their smooth, flattened bodies enable them to resist the pull of the current. Water pennies are usually found on smooth rocks where they graze on attached algae

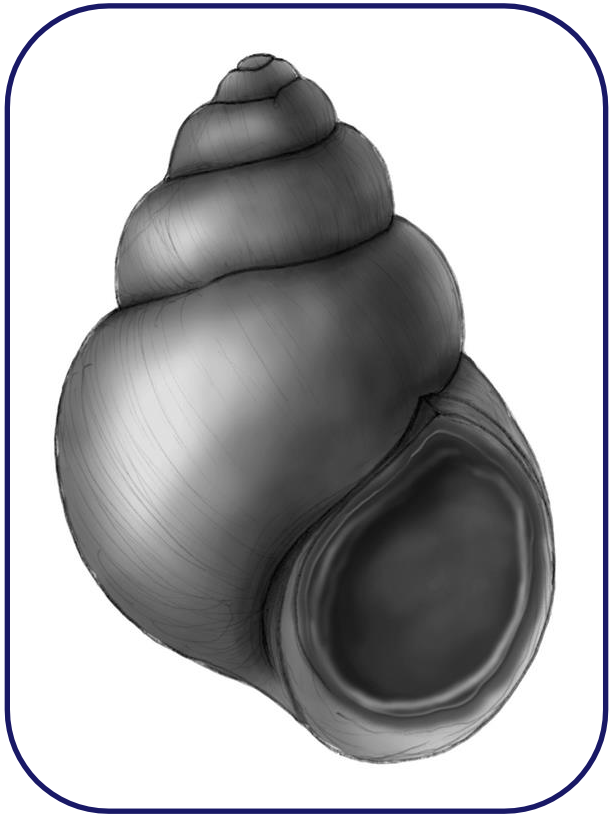
RIFFLE BEETLE

- Riffle beetles measure approximately **1/16 to 1/8 inch** in length
- Body small usually oval
- Legs are long
- Antennae are usually slender
- Riffle beetles walk slowly underwater. They do not swim on the surface.



GILLED SNAIL

- Measures **¼ to 1 inch**
- Shell **usually opens on right**
- Shell opening covered by a thin plate (operculum)
- **When monitoring, do not count empty shells!**

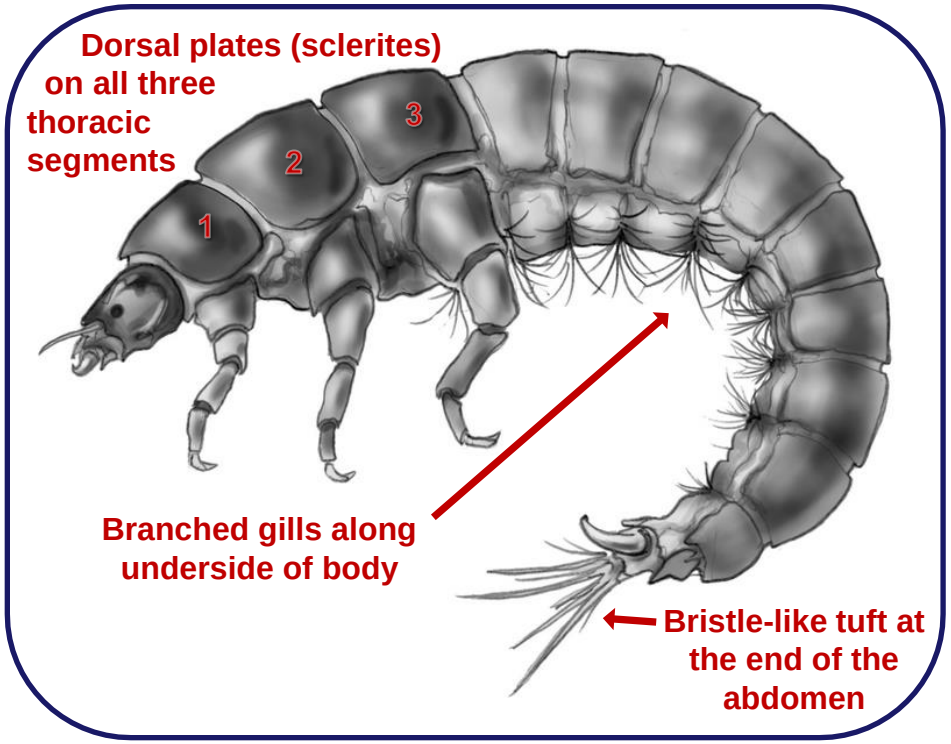


Somewhat Pollution Tolerant Organisms

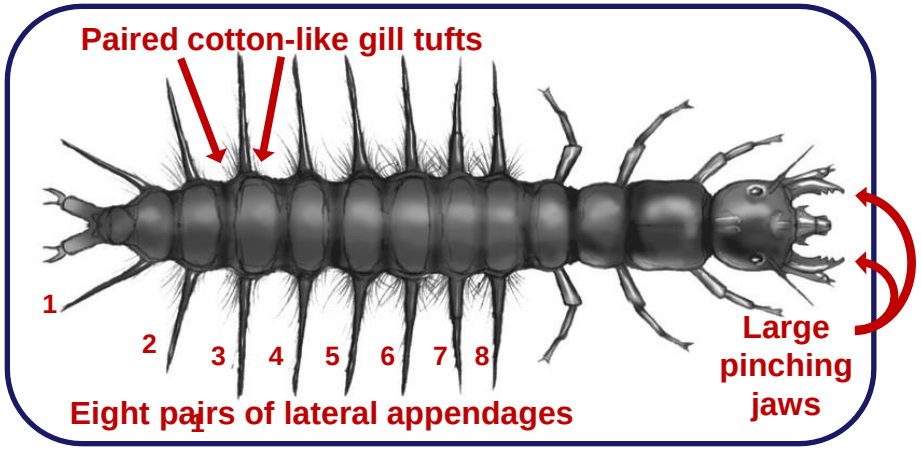
Require Moderate Levels of Dissolved Oxygen
Found In Good or Fair Quality Water

COMMON NET SPINNING CADDISFLY NYMPH

- Measures up to **1 inch**
- Body is caterpillar-like with **three pairs of legs**
- **Body is strongly curved**

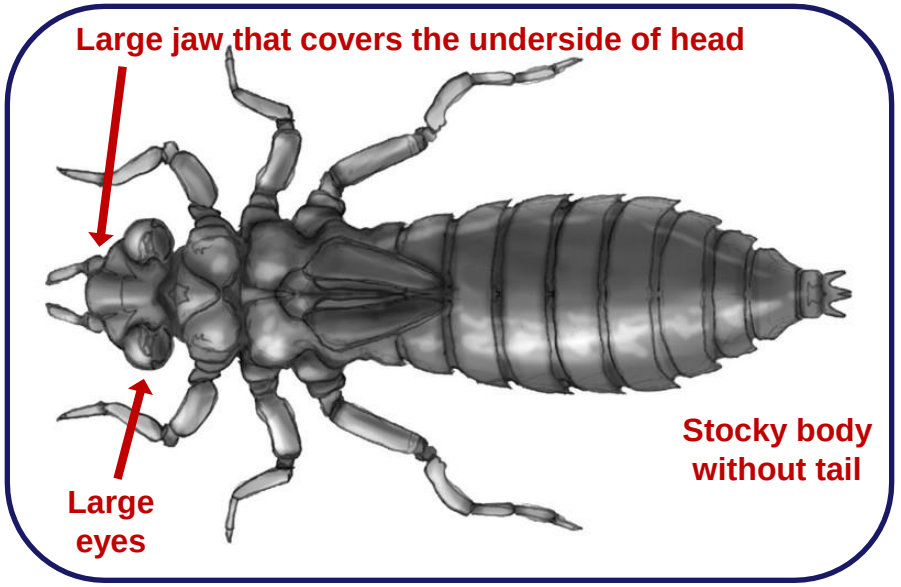


DOBSONFLY & FISHFLY LARVA



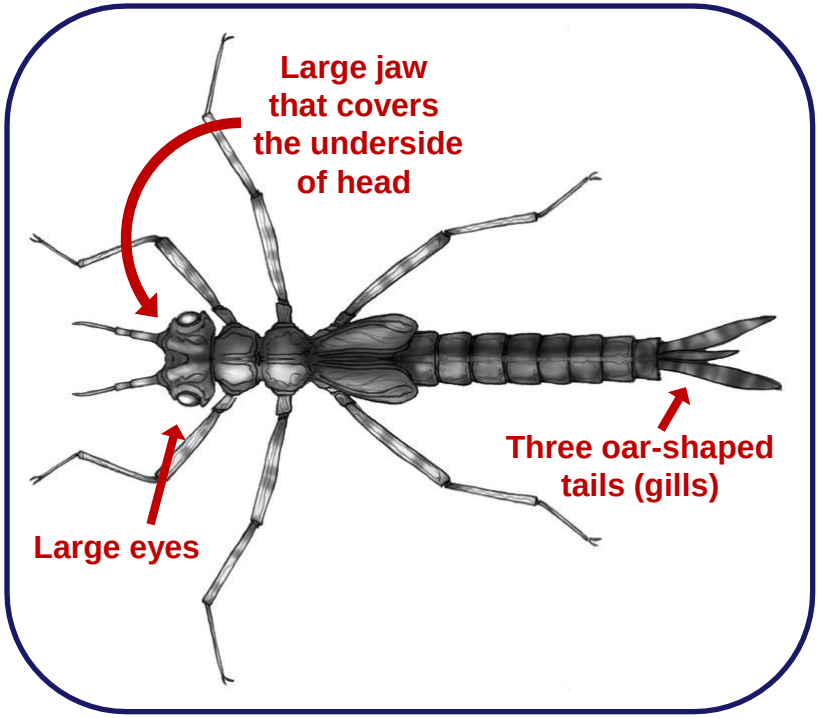
- Measure ¾ - **4 inches** in length
- Body is elongate and somewhat flattened
- Short inconspicuous antennae
- Abdomen terminates in two small prolegs, each bearing two claws
- Feeds on other aquatic insects
- Dobsonflies (hellgrammites) are usually found on the underside of large rocks in cool, slow-moving streams
- Handle Dobsonflies (hellgrammites) carefully - larger individuals may deliver a painful pinch!

DRAGONFLY NYMPH



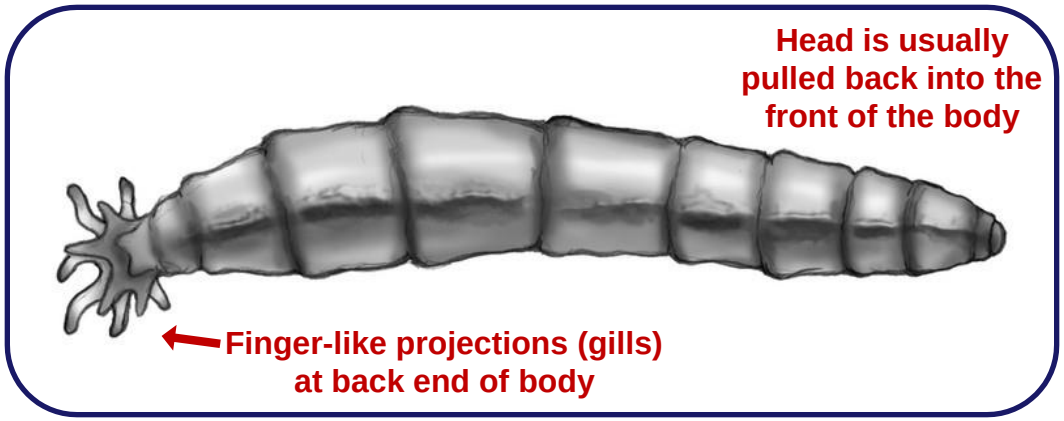
- Measures between **½ - 2 inches** in length
- **Two pairs of wing pads**
- Large round or oval abdomen
- Abdomen terminates in three small pointed structures
- Prefers cool, still water. Often found among vegetation and leaf packs or burrowed in sediment

DAMSELFLY NYMPH



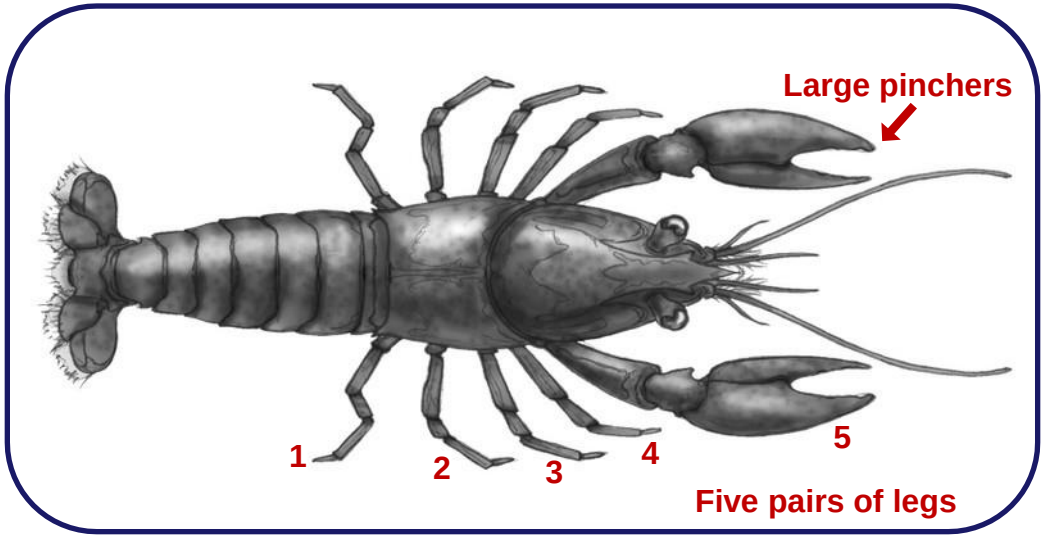
- Measure **½ - 1 inch** in length
- Abdomen usually much more narrow and slender than that of dragonflies

CRANEFLY LARVA



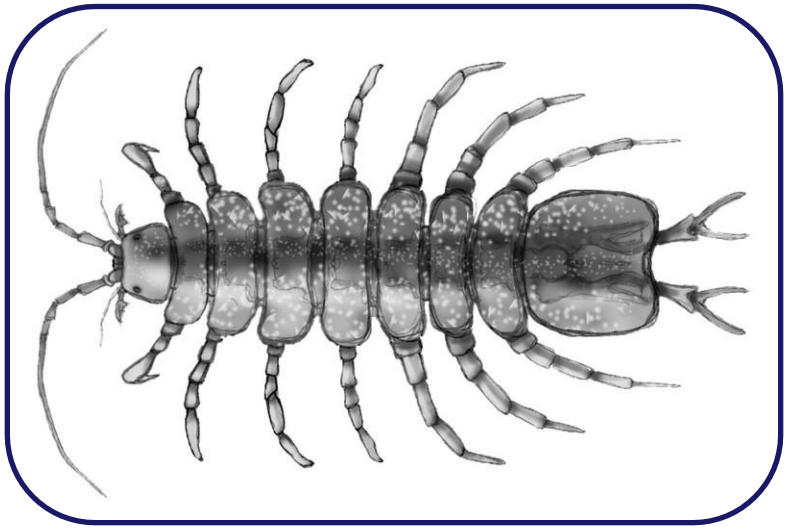
- Measure **1/3 – 2½ inches** in length
- Plump caterpillar-like segmented body
- Milky green to brown color

CRAYFISH



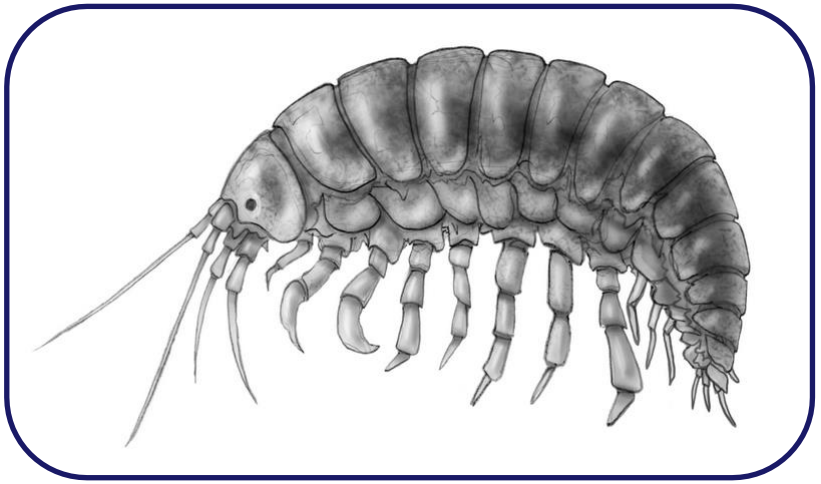
- Measure **up to 5 inches** in length
- Resembles a small lobster
- Crayfish are usually active only at night. During the day they hide in burrows or under rocks.
- Crayfish are omnivorous, eating both plants and animals.

AQUATIC SOWBUG



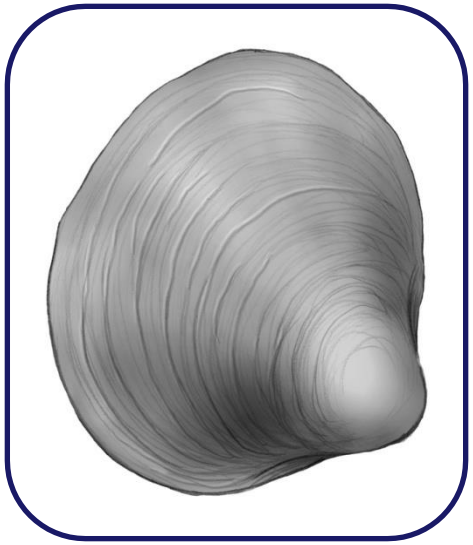
- Measures **¼ - ¾ inch** in length.
- Clear whitish to pink in color.
- Dorsoventrally flattened (top to bottom).
- Seven pairs of legs, the first two are modified for grasping.
- Found in shallow freshwater on rocks or detritus.

SCUD

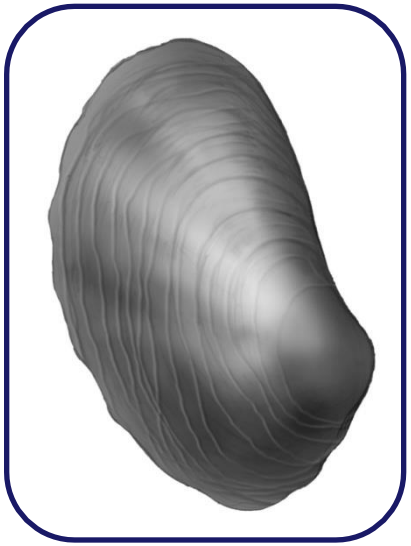


- Measure **1/8 – 1/4 inch** in length.
- Clear whitish to pink in color
- Laterally flattened (side to side)
- Found in shallow freshwater springs, streams, lakes and ponds
- Most species feed on detritus
- Scuds are an important food source for many fishes

CLAMS & MUSSELS



Clam



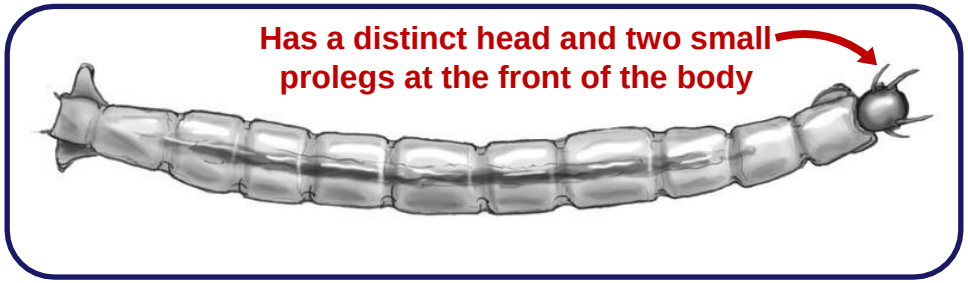
Mussel

- Fleshy body enclosed between two clamped shells
- If alive, shells cannot be pried apart
- When monitoring, do not count empty shells

Pollution Tolerant Organisms

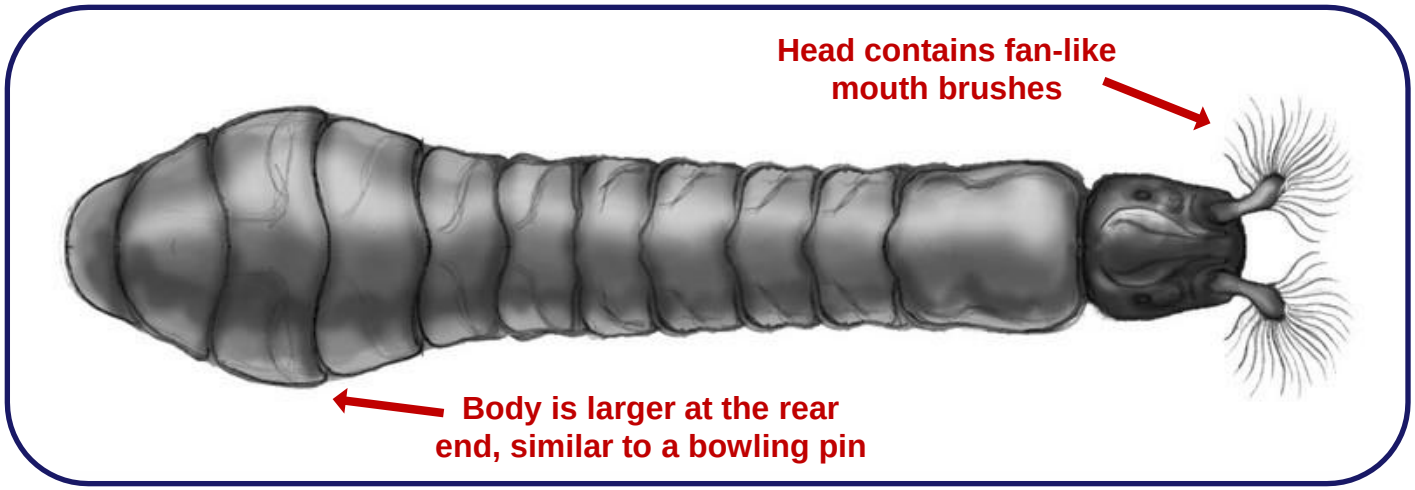
Can Survive in Low Levels of Dissolved Oxygen
Found In Any Quality Water

MIDGEFLY LARVA



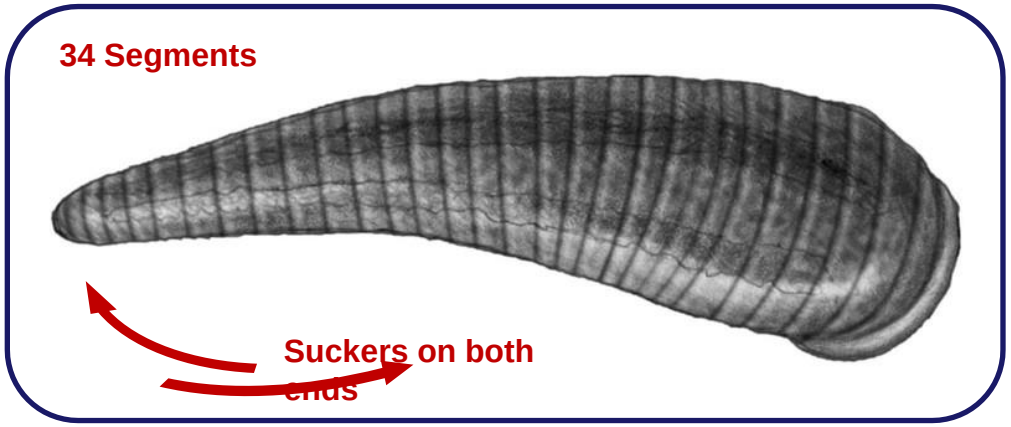
- Measure up to **¼ inch** in length
- Body small, cylindrical, and slightly curved
- Occasionally deep red in color, otherwise variously colored
- Two small prolegs just posterior to head
- Frequently found in bottom sediments of lakes, streams, and ponds where they feed on deposited organic material

BLACKFLY LARVA



- Measure to **¼ inch** in length
- Abdomen terminates in an attachment disc
- Blackfly larva prefer cold running water and are usually found attached by the end of their abdomens to rocks, woody debris, or vegetation in the currents of rivers and streams

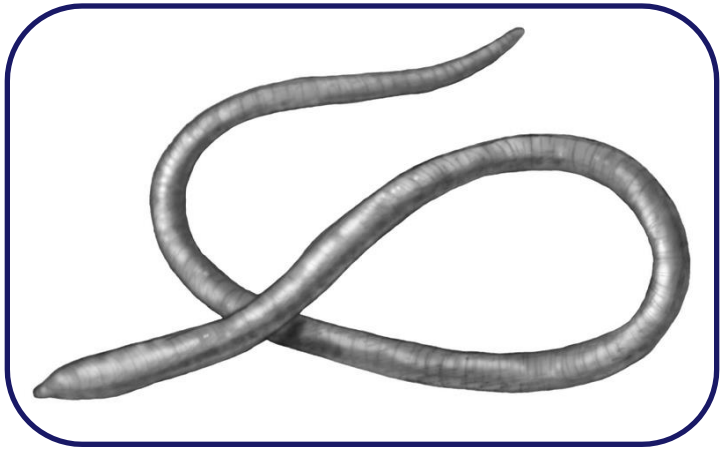
LEECH



- Measures **¼ - 2 inches** in length.
- Typically dorsoventrally flattened.
- Leeches are common in warm protected waters of lakes, ponds, streams, and marshes.
- Leeches usually avoid light by hiding under rocks or among aquatic vegetation or detritus.
- Silty substrates are unsuitable for leeches because they cannot attach properly.

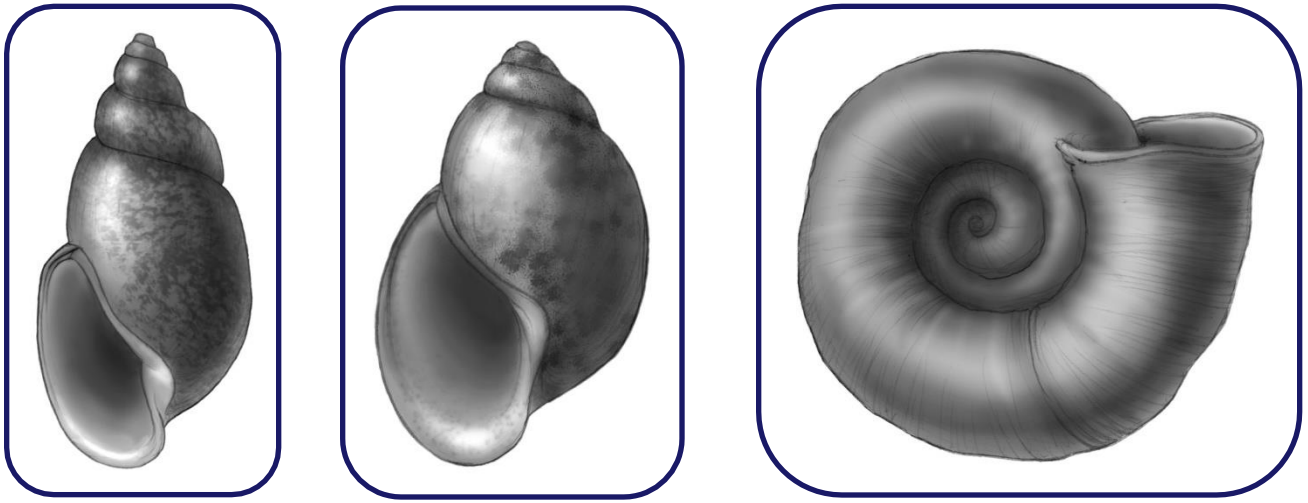
AQUATIC WORM

- Usually measure **about 1 inch** in length, but **up to 4 inches**.
- Clear whitish to pink in color.
- Body consists of 7 to 500 segments.
- Segments often have bristles or hairs.



- Tolerant of low dissolved oxygen concentrations.
- Found in silty substrates and among debris or detritus in ponds, lakes, streams and rivers.
- Dense populations of Tubificids can often be found in organically polluted rivers.
- Approximately 200 species in North America

LUNGED SNAILS



- Measures **up to 2 inches**
- Shell **usually opens to the left** when pointed end is up
- Breathes air
- No operculum
- **When monitoring, do not count empty shells!**